The DS3 Mission: A Separated Spacecraft Optical Interferometer

by
R. P. Linfield and P. W. Gorham
Jet Propulsion Laboratory, California Institute of Technology

The DS3 mission will be a separated spacecraft interferometer, with baselines up to at least 1000 m and a source detection threshold of visual magnitude 12–13. Launch is planned for 2002.

There will be two spacecraft with collecting apertures of diameter 12–20 cm, and one combiner spacecraft, all located in an earth trailing orbit at 1 A.U.. Source direction and baseline changes will be made using pulsed plasmas thrusters. Due to the long time required for aperture synthesis with a single baseline, only 50–100 sources can be observed during the expected mission duration of 6–12 months. Fringes will be detected in white light, and then measured in 50–100 spectral channels over the 0.5–0.9μm band. The interferometer will primarily measure only visibility amplitudes, giving simple structure information for compact sources, down to a resolution limit of 100 microarcseconds.

The simplest astronomical measurements will be the angular sizes of hot stars. Other potential targets include Wolf-Rayet and FU Ori stars. DS3 will be able to image the mass outflow in Wolf-Rayet stars in several of their strongest spectral lines, giving a measurement of density and temperature as a function of distance from the star. For FU Ori stars, the accretion disk should be resolvable. Measurements of fringe visibility as a function of wavelength will yield the temperature *vs.* radius in the accretion disk.

One very interesting target will be Cygnus X-1. The luminous primary star should be partially resolved on the longer DS3 baselines, allowing a direct distance estimate. Simple shape measurements will test the assertion that this star fills its Roche lobe. Observing the changes in shape as the star rotates will yield the inclination of the orbital plane to our line of sight. This inclination is a crucial quantity when using the observed radial velocity curve to constrain the mass of the presumed black hole.